Ocean Surface Topography and Circulation

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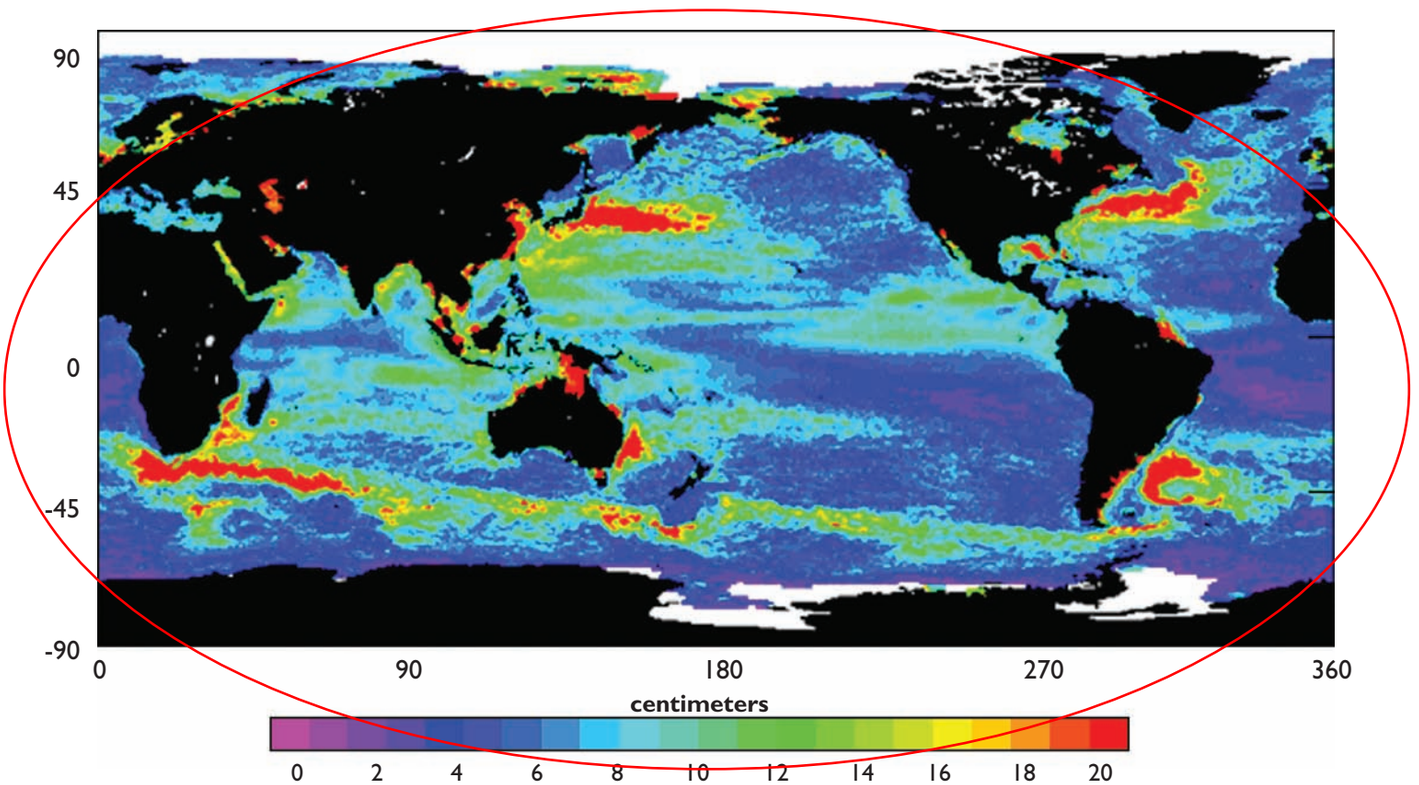

Variability of the ocean surface topography derived from radar altimeter measurements. The variability reflects the presence of ocean eddies. (Data from TOPEX/Poseidon and ERS satellites. Image processing by P-Y. Le Traon.)

Surfers and sailors are well aware of the ocean's turbulent nature as displayed by breaking waves and swirling currents. Current meters in the ocean are tossed around, making it difficult to measure the speed and direction of currents. Measurements from these instruments are often dominated by random waves rather than by the steady flow that is of interest to navigators and fishermen. Only after averaging a large number of measurements is it possible to detect a steady flow. This steady flow is what we usually refer to as ocean circulation. It transports the heat stored in the ocean around the world and controls weather and climate.

The slow movement of ocean circulation is driven by the differences in pressure created by the variation of sea-surface elevation. Contrary to our intuition, the ocean surface is not flat but has hills and valleys. If the ocean is at rest, the sea-surface elevation is determined by Earth's gravity. This shape is called the geoid. When the ocean is in motion, its surface elevation departs from the geoid, leading to a pressure force that balances the motion. The deviation of the sea-surface elevation from the geoid is called ocean surface topography. Knowledge of the ocean surface topography allows us to calculate the speed and direction of ocean currents. The TOPEX/Poseidon satellite, operated jointly by the United States and France, has been making measurements of ocean surface topography since October, 1992. The data provide the first global view of ocean circulation and how it changes on time-